EXTENT OF ROADWAY CAPACITY SHIFT RESULTING FROM MIDBLOCK U-TURN FACILITIES

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TO MY BELOVED....

Father (Misbah Bin Mohd Tap)
Mother (Hajar Binti Adam) dan Family,

Thank You for Your Support!!

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"In the name of Allah with the Most Compassionate, the Most Merciful"

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ABSTRACT

Midblock U-turn facilities are a one of the highway facilities that constructed to provide the U-turn movement for the driver to change the direction. In Malaysia, it is generally constructed at federal multilane highway. Introducing of roadway facilities such as midblock U-turn along the highway segment will give the benefits and at the same time give the risk to the road user. U-turning movements at the midblock U-turn facilities can cause the road safety problem due to the vehicle movement in order to make a U-turn. The aim of study is to determine the extent of road capacity shift resulting from midblock U-turn facilities. In order to know the condition and operational performance of the roadway, the traffic flow need to analysed for the road segment consist of midblock U-turn Facilities at Skudai – pontian Highway. Based on the hypothesis that capacity loss would result from U–turning at midblock U-turn facilities; 24 hours data were collected as volume and speed at two sites in Skudai Town, Malaysia. Automatic traffic counter was used to collect the traffic data such as volume and speed of the road section with and without influence by midblock U-turn facilities. The analyses of traffic data are continued by using fundamental relationship of speed and density to estimate the roadway capacity value. Results show that there is a difference in capacity between carriageway lane affected by midblock U-turn facilities and carriageway lane no affected by midblock U-turn facilities. The study concluded that capacity loss is about 28.3% for Site A and 8.1 % for Site B would occur. It is correct to conclude that the hypothesis that the capacity loss would result from U turning at midblock U-turn facilities is valid.

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ABSTRAK

Kemudahan pusingan–U adalah salah satu kemudahan jalan raya yang dibina untuk kemudahan pergerakkan membuat pusinga–U bagi pemandu menukar arah perjalanan. Di Malaysia, kemudahan pusingan–U sering dibina di jalan raya persekutuan. Kemudahan jalan raya seperti kemudahan pusingan–U yang dibina sepanjang lebuh raya memberikan manfaat dan pada masa yang sama juga memberikan risiko kepada pengguna jalan raya. Pergerakkan bagi membuat pusingan-U sering menyumbangkan kepada masalah keselamatan di jalan raya disebabkan oleh kenderaan yang ingin membuat pusingan-U. Disamping itu, prestasi operasi jalan raya juga turut terjejas apabila kemudahan pusingan – U diperkenalkan di jalan raya. Dalam usaha untuk mengetahui keadaan dan pretasi operasi jalan raya yang mempunyai kemudahan pusingan–U di Lubuhraya Skudai - pontian, aliran traffik untuk jalan tersebut perlu dianalisis. Berdasarkan hipotesis bahawa kehilangan kapasiti disebabkan oleh pergerakan pusingan-U; traffic data dalam masa 24 jam telah dikumpulkan bagi kedua-dua lokasi kajian di Skudai, Malaysia. Cerapan Traffic Automatik digunakan untuk mengumpul data trafik seperti jumlah kenderaan ann kelajuan pada jalan yang dipengaruhi pusingan – U dan tidak dipengaruhi. Analisis data trafik diteruskan dengan menggunakan hubungan asas antara kelajuan dan ketumpatan untuk menggangar nilai kapasiti jalan. Hasil kajian menunjukkan bahawa terdapat perbezaan kapasiti antara seksyen jalan yang tidak dipengaruhi oleh kemudahan pusingan-U dan seksyen jalan yang dipengaruhi oleh kemudahan pusingan-U. Keputusan kajian menunjukkan bahawa kehilangan kapasiti untuk lokasi A adalah sebanyak 23.8% dan 8.1% bagi lokasi B. Ia adalah tepat untuk menyimpulkan hipotesis bahawa kehilangan kapasiti disebabkan oleh kemudahan pusingan-U adalah kekal sah.

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LIST OF ABBREVIATIONS/SYMBOLS

ATC	Automatic Traffic Count
HCM	Highway Capacity Manual
HGV	Heavy Goods Vehicle
hr	Hour
JKR	Jabatan Kerja Raya
k	Density
k_c	Critical density
k_j	Jam density
km	Kilometer
PCU	Passenger Car Unit
Q	Capacity
q	Flow
q_{max}	maximum flow
R^2	Regression
SSD	Stopping Sight Distance
u	speed
u_f	Free flow speed
u_c	Optimum Speed
veh	Vehicle

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CHAPTER 1

INTRODUCTION

1.1 Background of The Study

Transportation systems have grown rapidly in Malaysia. It is parallel with development of country in present day. The transportation facilities such as highway should be provided for community development. A roadway is one of the important transportation facilities to support human movement from one place to another place in daily life. In addition, the increasing numbers of population in Malaysia from 11,442,086 in 1980 to 28,910,000 in 2010 are lead to development of transport system include road facilities in Malaysia. Malaysia highway can be classified as expressway; federal road, state road, municipal highways and other. Generally, rapid development and increasing number of vehicles on the road can be contributed to traffic congestion.

Road traffic congestion can be defined as a condition on the road networks where the volume of vehicle is increases and it cause slower speeds, longer trip times and increase vehicular queuing. Traffic congestion and its impacts significantly affect the nation economic performance and the public's quality of life. In the most urban areas, travel demand routinely exceeds highway capacity during peak periods. Furthermore, there are some events can be contributed to the congestion of highway network and cause capacity losses, the event including crashes, vehicle breakdowns,

adverse weather, railroad crossing, sub-optimal signal timing, toll collection facilities and U-turn turning movement. Sometime, traffic congestion can contribute to the lack of highway operational performance and road safety problem.

In order to give the better operational performance and reduce the road safety problem, the proper planning should be done in the early stage. The estimation of the capacity is importance that used in planning, design and operation of roadway. The traffic analysis is used to predict the time and location where traffic congestion is likely to occur, the amount of delay associated with congestion and the expected traffic volume at bottlenecks. Traffic analysis also used to improve the road facilities to give a user to ride safely and comfortably at design speed. Therefore, it is imperative that traffic analysis can be able to clearly define and measure capacity of roadway.

Fundamental diagram is usually used to estimate the capacity value of roadway. Greenshields (1935) have been explained the concept of fundamental diagram that can be used for traffic analysis. The relationship between traffic variable such as speed, flow and density can be used to describe the traffic quality and roadway condition. Besides that, there are many methods that can be used to estimate the roadway capacity. Minderhoud *et al* (1997) have been explained the different methods for capacity estimation method. The method for direct empirical include capacity estimation with headway method, capacity estimation with volume methods, capacity estimation with volume and speed methods and capacity estimation with volume, speed and density methods. The choice of a particular method depends largely on the data collected and purpose of estimation.

1.2 Statement of the problem

Midblock U-turn facilities are a one of the highway facilities that constructed to provide the U-turn movement for the driver to change the direction. In Malaysia, it

is generally constructed at federal multilane highway. Generally, midblock U-turn facilities at the highway are built with providing splitting island at a middle of road section. It is the part of traffic management to improve intersection operation, some traffic movement are not permitted at some intersection location. Compare with turning movement at intersection, U-turn movement at midblock U-turn facilities is more complex and higher of risk to road user.

Installation of midblock U-turn facilities at multilane highway will lead to safety problem and reducing the highway operational performance. Safety problem may be occur when driver change the lane from outer lane to inner lane to make a U-turn movement and reduce the speed during diverging activity. The dangerous movements also happen when driver trying to merging with a main road after make a U-turn movement and accelerate the speed.

In addition, midblock U-turn facilities will cause the differential of capacity value between fast lane and slow lane compare with highway without midblock U-turn facilities, the capacity value for fast lane and slow lane are same. The different between the capacity values may give the capacity loss for the road segment. Therefore, it is importance to estimate the capacity value at maximum flow for the midblock U-turn facilities at the highway segment.

1.3 Purpose and Objective of The Study

The main purpose of this study is to determine the extent of roadway capacity shift resulting from highway midblock U-turn facilities and the objectives of this study are:

a) Estimate speed, flow and density for road section with and without midblock U-turn facilities, Hence

b) Use flow and density function to estimate capacity for road section with and without midblock U-turn facilities
c) Compare capacity outcomes, hence determine capacity loss.

1.4 Scope of the study

The scope of the study is mainly focused to determine the capacity shift due to the U-turning movement on the roadway. The capacity shift will be determine with two different condition of capacity which is the capacity of roadway influence by the midblock U-turn facilities know as inner lane and the roadway capacity without midblock U-turn facilities know as outer lane.

The data had been taken under the dry weather condition in order to eliminate the effect of rainy on the roadway capacity. Besides that, this study only focuses on free flow condition during weekdays. The study will provide traffic data including volume and speed for the highway section during three weeks continuously.

In this study, the area will focus on the area of the midblock U-turn at the highway section located at Skudai-Pontian Highway. Figure 1.1 shows the location of the study area at Skudai-Pontian Highway and Figure 1.2 show the picture of midblock U-turn facilities at Skudai Pontian Highway.

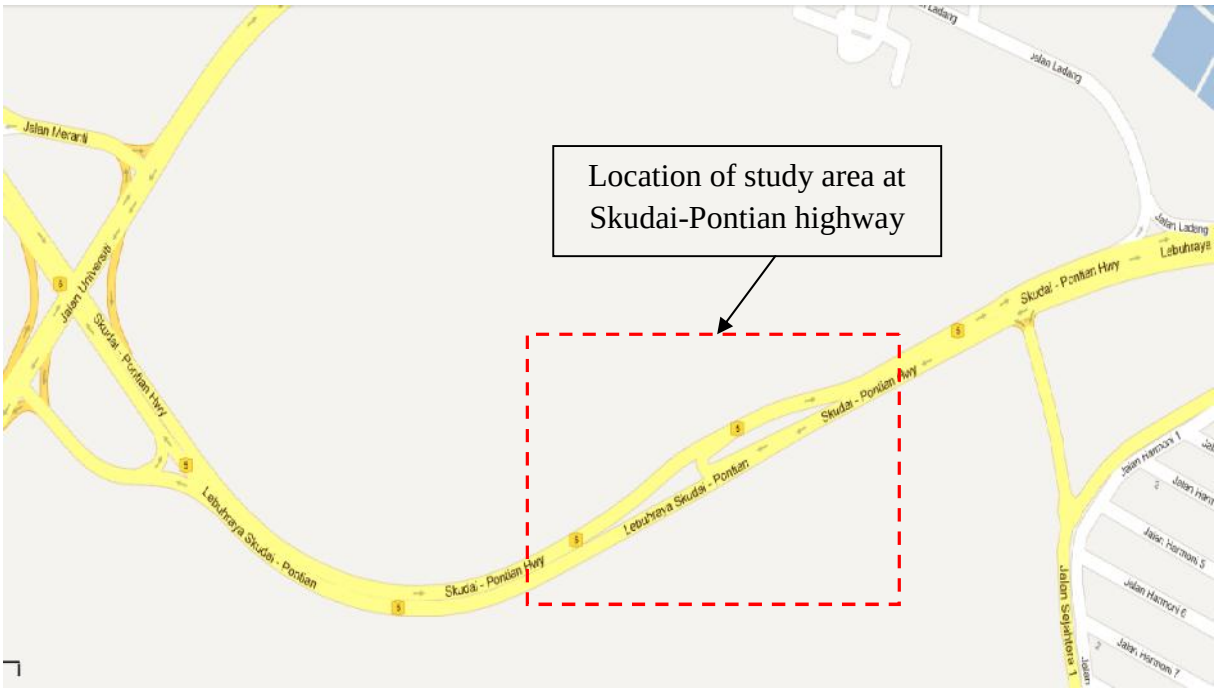

Figure 1.1: Location of Study Area

(Source: http://maps.google.com)

Figure 1.2: Midblock U-turn Facilities at Skudai-Pontian Highway.

1.5 Significant of study

The result from this study will provide the value of the capacity for the road section that contained midblock U-turn facilities. The Capacity of the roadway is importance to predict the performance of the roadway at maximum flow in order to reduce the traffic congestion. In the future, the finding of this study is importance to help the local authorities to improve in the road geometry design at the road segment.

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